

REMARKS

Claims 1, 6-15, 21-26 and 31-33 are now pending in the application. Claims 1, 6-15, 21-26 and 31-33 stand rejected. Claims 2-5, 16-20 and 27-30 are cancelled.

The Examiner is respectfully requested to reconsider and withdraw the rejections in view of the amendments and remarks contained herein.

REJECTION UNDER 35 U.S.C. § 103

1. Claims 1, 6, 9, 10 and 12-14 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Early (U.S. Pat. No. 5,756,924) in view of Few et al. (U.S. Pat. No. 5,404,712) and Bussing (U.S. Pat. No. 6,062,018).

As previously presented, Claim 1 recites, "A device for optically establishing a combustive reaction with a slurry fuel and air mixture, said device comprising: an optical energy source for generating an optical signal for interacting with the slurry fuel and air mixture to create a combustive reaction; at least one combustion chamber containing the slurry fuel and air mixture therewithin; a transfer device for optically interconnecting said optical energy source with said combustion chamber; and an intensity profiler for modifying the optical signal to have a high peak power at a leading edge of the optical signal for igniting the slurry fuel and air mixture to initiate the combustive reaction and a lower peak power during a remainder of the optical signal to maintain the combustive reaction of the slurry fuel and air mixture after the ignition."

Applicants respectfully submit that neither Early, Few et al. nor Bussing, either singly or in combination, describe, show or suggest a device for optically establishing a combustive reaction with a slurry fuel and air mixture having the limitations recited in Claim 1. For example, neither Early, Few et al. nor Bussing describe, show or suggest a device for optically establishing a combustive reaction with a slurry fuel and air mixture that includes an intensity profiler for modifying *an optical signal* to have a *high peak power at a leading edge* for igniting the slurry fuel and air mixture within a combustion chamber to initiate the combustive reaction and *a lower peak power during a remainder of the optical signal* to maintain the combustive reaction.

Rather, Early describes a system that utilizes *two or more* laser light pulses with certain differing temporal lengths and peak pulse powers employed in a sequence to

regulate the rate and duration of laser energy delivered to a fuel mixture. Few et al. describes a method and apparatus for igniting an air/fuel spray comprised of fuel droplets. The apparatus includes a coherent optical source for introducing at least one pulse of coherent radiation into the air/fuel spray. The pulse generates free electrons and initiates a development of a plasma within the air/fuel spray. *The pulse is terminated at a time after the plasma has reached a predetermined energy and before ignition of the air/fuel spray.* Bussing describes a pulse detonation energy generator that may have one or more detonation chambers, a fuel manifold, an air manifold, a pre-mixer, and a *predetonator* constructed to fire into the one or more detonation chambers to for initiating detonation in the detonation chambers. Thus, neither Early, Few et al. nor Bussing describe, show or suggest the device for optically establishing a combustive reaction with a slurry fuel and air mixture recited in Claim 1.

Furthermore, Applicants respectfully submit that one of reasonable skill in the art would clearly understand that the apparatus shown and described in Early can not approximate a single pulse format, despite the Office's reference to column 6, lines 55-60, of Early. Particularly, the hardware explicitly shown in Early uses a beam splitter 22 used to combine the two beams. Actually, one skilled in the art would interpret Early to describe the beam splitter 22 to be a beam combiner, because it is not splitting beams, but rather combining beams. Further, upon reading Early, one skilled in the art, would understand that the beam splitter (combiner) of Early must be a polarization sensitive optic. That is, one laser is polarized in one orientation and the other laser is polarized in the other orientation. One skilled in the art would readily understand that the only way that the optic 22 could do what it is described to do, is if it were a polarization sensitive optic. Accordingly, the light input to combust fuel/oxidizer mixture 28, using the system shown and described in Early will have two polarizations, one at high power and the other at lower power.

Conversely, the presently claimed invention, as recited in Claim 1, generates a single laser pulse with a single polarization state, because it a single pulse. This is a significantly distinguishing characteristic of the present invention from that described in Early, because a specific polarization, especially in the nonlinear breakdown, will induce a plasma that is strongly oriented in a preferential direction.

In Early, the preferential direction of plasma will be perpendicular to the orientation of the second pulse polarization. With the polarization of the breakdown of the higher power pulse orthogonally related to the lower power pulse, the nature of the interaction changes significantly and may, in fact, alter the requirements of the lower power pulse.

Applicants respectfully submit that the single pulse of the claimed invention, as recited in Claim 1, would not be composed of orthogonal polarization orientations and, in fact, orthogonal polarizations would like lead to suboptimal performance of the present invention.

Thus, Applicants respectfully submit that Early does not describe, show or suggest an intensity profiler for modifying a *single optical signal* to have a high peak power at a leading edge and a lower peak power during a remainder of the optical signal. Rather, Early describes utilizing *two or more* laser light pulses with certain differing temporal lengths and peak pulse powers employed in a sequence to regulate the rate and duration of laser energy delivered to a fuel mixture. Additionally, column 6, lines 55-60, of Early describes “(or a single pulse *which can approximate the characteristics of the **two sequential pulse of this invention***)” . Applicants respectfully submit that, as set forth above, the characteristics of two sequential pulses described in Early are not described or shown as, and in fact can not be, the same as the characteristics of the modified single pulse, as recited in Claim 1 and described throughout the present specification.

Accordingly, Applicants respectfully submit that neither Early, Few et al. nor Bussing, independently or in combination, describe, show or suggest the device for optically establishing a combustive reaction with a slurry fuel and air mixture recited in Claim 1.

Further yet, Applicants respectfully submit that there is no motivation to combine Early and Few et al, either independently or in combination, with Bussing. As set forth above, Bussing describes a pulse detonation energy generator that may have one or more detonation chambers, a fuel manifold, an air manifold, a pre-mixer, and a *predetonator constructed to fire into the one or more detonation chambers* to for initiating detonation in the detonation chambers. One skilled in the art would readily and

clearly understand that, as described in Bussing, a predetonation chamber is used eject a flame in to a main chamber to ignite the main chamber. Applicants respectfully submit that, since Bussing describes optical ignition within a predetonation chamber, as opposed to optical ignition within the main detonation chambers, one skilled in the art would readily conclude that the optical ignition of the predetonation chamber, as described in Bussing, teaches away from optical ignition within the main detonation chambers. Accordingly, for at least the reasons set forth above, Applicants respectfully submit that one skilled in the art would not have been motivated to combine the teaching of Early, Few et al. and Bussing to construct the present invention as recited in Claim 1.

Therefore, for at least the reasons set forth above, Applicants respectfully submit that Claim 1 is patentable over Early in view of Few et al. and Bussing. Claims 6, 9, 10 and 12-14 depend from Claim 1. When the recitations of Claim 6, 9, 10 and 12-14 are considered in combination with the recitations of Claim 1, Applicants submit that Claims 6, 9, 10 and 12-14 are likewise patentable over Fuss et al. in view of Bussing.

For the reasons set forth above, Applicants respectfully request that the §103 of Claims 1, 6, 9, 10 and 12-14 be withdrawn.

2. Claims 7 and 11 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Early (U.S. Pat. No. 5,756,924), in view of Bussing (U.S. Pat. No. 6,062,018) and further in view of Few et al. (U.S. Pat. No. 5,404,712). Claims 7 and 11 depend from Claim 1, which, in accordance with the remarks set forth above, Applicants respectfully submit is patentable over the cited references, Early in view of Few et al. and Bussing. Thus, when the recitations of Claims 7 and 11 are considered in combination with the recitations of Claim 1, Applicants submit that Claims 7 and 11 are patentable over Early in view of Bussing and Few et al.

For the reasons set forth above, Applicants respectfully request that the §103 of Claims 7 and 11 be withdrawn.

3. Claim 8 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Early (U.S. Pat. No. 5,756,924) in view of Bussing (U.S. Pat. No. 6,062,018), Few et al. (U.S. Pat. No. 5,404,712) and Firnberg et al. (U.S. Pat. No. 5,374,405).

Claim 8 depends from Claim 1, which, in accordance with the remarks set forth above, Applicants respectfully submit is patentable over the cited references, Early in view of Few et al. and Bussing. Thus, when the recitations of Claim 8 are considered in combination with the recitations of Claim 1, Applicants submit that Claim 8 is patentable over Early in view of Bussing, Few et al. and Firnberg et al.

For the reasons set forth above, Applicants respectfully request that the §103 of Claim 8 be withdrawn.

4. Claims 15, 21, 23-26, 32 and 33 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Early (U.S. Pat. No. 5,756,924) in view of Bussing (U.S. Pat. No. 6,062,018), Few et al. (U.S. Pat. No. 5,404,712) and further in view of Hunt et al. (U.S. Pat. No. 6,385,963).

A. Regarding Claims 15, 21 and 23-25, as previously presented, Claim 15 recites, "A device for optically establishing a combustive reaction with a slurry fuel and air mixture, said device comprising: at least one combustion chamber containing the slurry fuel and air mixture therewithin; an optical energy source adapted to generate an optical signal for interacting with the slurry fuel and air mixture to create a combustive reaction; a optical fiber for optically interconnecting said optical energy source with said combustion chamber; and an optical wavelength filter adapted to filter said optical signal such that residual light having wavelengths longer than a specified length is removed; and an intensity profiler for modifying the optical signal to have a high peak power at a leading edge of the optical signal for igniting the slurry fuel and air mixture to initiate the combustive reaction and a lower peak power during a remainder of the optical signal to maintain the combustive reaction of the slurry fuel and air mixture after the ignition."

Applicants respectfully submit that neither Early, Bussing, Few et al. nor Hunt et al., either singly or in combination, describe, show or suggest a device for optically establishing a combustive reaction with a slurry fuel and air mixture having the limitations recited in Claim 15. For example, neither Early, Bussing, Few et al. nor Hunt et al. describe, show or suggest a device for optically establishing a combustive reaction with a slurry fuel and air mixture that includes an intensity profiler for modifying *an optical signal* to have *a high peak power at a leading edge* for igniting the slurry fuel and

air mixture to initiate the combustive reaction and *a lower peak power during a remainder of the optical signal* to maintain the combustive reaction.

Furthermore, Applicants respectfully submit that one of reasonable skill in the art would clearly understand that the apparatus shown and described in Early can not approximate a single pulse format, despite the Office's reference to column 6, lines 55-60, of Early. Particularly, the hardware explicitly shown in Early uses a beam splitter 22 used to combine the two beams. Actually, one skilled in the art would interpret Early to describe the beam splitter 22 to be a beam combiner, because it is not splitting beams, but rather combining beams. Further, upon reading Early, one skilled in the art, would understand that the beam splitter (combiner) of Early must be a polarization sensitive optic. That is, one laser is polarized in one orientation and the other laser is polarized in the other orientation. One skilled in the art would readily understand that the only way that the optic 22 could do what it is described to do, is if it were a polarization sensitive optic. Accordingly, the light input to combust fuel/oxidizer mixture 28, using the system shown and described in Early will have two polarizations, one at high power and the other at lower power.

Conversely, the presently claimed invention, as recited in Claim 15, generates a single laser pulse with a single polarization state, because it a single pulse. This is a significantly distinguishing characteristic of the present invention from that described in Early, because a specific polarization, especially in the nonlinear breakdown, will induce a plasma that is strongly oriented in a preferential direction.

In Early, the preferential direction of plasma will be perpendicular to the orientation of the second pulse polarization. With the polarization of the breakdown of the higher power pulse orthogonally related to the lower power pulse, the nature of the interaction changes significantly and may, in fact, alter the requirements of the lower power pulse.

Applicants respectfully submit that the single pulse of the claimed invention, as recited in Claim 15, would not be composed of orthogonal polarization orientations and, in fact, orthogonal polarizations would like lead to suboptimal performance of the present invention.

Thus, Applicants respectfully submit that Early does not describe, show or suggest an intensity profiler for modifying a *single optical signal* to have a high peak power at a leading edge and a lower peak power during a remainder of the optical signal. Rather, Early describes utilizing *two or more* laser light pulses with certain differing temporal lengths and peak pulse powers employed in a sequence to regulate the rate and duration of laser energy delivered to a fuel mixture. Additionally, column 6, lines 55-60, of Early describes “(or a single pulse *which can approximate the characteristics of the **two sequential pulse of this invention***)”. Applicants respectfully submit that, as set forth above, the characteristics of two sequential pulses described in Early are not described or shown as, and in fact can not be, the same as the characteristics of the modified single pulse, as recited in Claim 15 and described throughout the present specification.

Descriptions of Early, Bussing and Few et al. are set forth above. Hunt et al. describes an optical system including an optical source capable of producing light having physical characteristics sufficient for optically driven chemical disassociation of a fuel. The system includes an optical delivery system for providing optical delivery of light from the optical source to a chemical fuel source. The endothermic fuel generation is produced by the non-linear, optical interaction of the produced light with the fuel, thereby leading to molecular dissociation of the fuel. Thus, neither Early, Bussing, Few et al. nor Hunt et al. describe, show or suggest the device for optically establishing a combustive reaction with a slurry fuel and air mixture recited in Claim 15.

Therefore, for at least the reasons set forth above, Applicants respectfully submit that Claim 15 is patentable over Early in view of Bussing, Few et al. and Hunt et al. Claims 21 and 23-25 depend from Claim 15. When the recitations of Claims 21 and 23-25 are considered in combination with the recitations of Claim 15, Applicants submit that Claims 21 and 23-25 are likewise patentable over Early, in view of Bussing, Few et al. and Hunt et al.

B. Regarding 26, 32 and 33, the limitations recited in Claim 26 are similar to the recitations recited in Claim 15. In accordance with the remarks set forth above with respect to Claim 15, Applicants respectfully submit that Claim 26 is also patentable over Early, in view of Bussing, Few et al. and Hunt et al.

Claims 32 and 33 depend from Claim 26. When the recitations of Claims 32 and 33 are considered in combination with the recitations of Claim 26, Applicants submit that Claims 32 and 33 are likewise patentable over Early, in view of Bussing, Few et al. and Hunt et al.

For the reasons set forth above, Applicants respectfully request that the §103 of Claims 15, 21, 23-26, 32 and 33 be withdrawn.

5. Claims 22 and 31 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Early (U.S. Pat. No. 5,756,924) in view of Bussing (U.S. Pat. No. 6,062,018), Few et al. (U.S. Pat. No. 5,404,712), Hunt et al. (U.S. Pat. No. 6,385,963), and further in view of Firnberg et al. (U.S. Pat. No. 5,374,405).

A. Regarding Claim 22, Claim 22 depends from Claim 15, which, in accordance with the remarks set forth above, Applicants respectfully submit is patentable over the cited references, Early in view of Bussing, Few et al. and Hunt et al. Thus, when the recitations of Claim 22 are considered in combination with the recitations of Claim 15, Applicants submit that Claim 22 is patentable over Early in view of Bussing, Few et al., Hunt et al. and Firnberg et al.

B. Regarding Claim 31, Claim 31 depends from Claim 26, which, in accordance with the remarks set forth above, Applicants respectfully submit is patentable over the cited references, Early in view of Bussing, Few et al. and Hunt et al. Thus, when the recitations of Claim 31 are considered in combination with the recitations of Claim 26, Applicants submit that Claim 31 is patentable over Early in view of Bussing, Few et al., Hunt et al. and Firnberg et al.

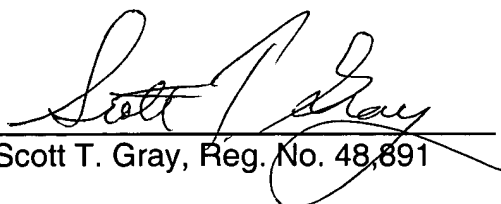
For the reasons set forth above, Applicants respectfully request that the §103 of Claims 22 and 31 be withdrawn.

CONCLUSION

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated or rendered moot. Applicants therefore respectfully request that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office Action and, as such, the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (314) 726-7525.

Respectfully submitted,

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